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Sir,

Applicant hereby requests to enter into record the enclosed certified copy of Finnish patent application #20011856, filed September 20, 2001. Applicant claims the benefit of priority to this application in accordance with 35 USC 119.

Respectfully submitted

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Hakija Applicant	**Oplayo Oy** **Helsinki**
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Kansainvälinen luokka International class	**G06F**

Keksinnön nimitys
Title of invention

"Adaptive media stream"
(Adaptiivinen mediavirta)

Täten todistetaan, että oheiset asiakirjat ovat tarkkoja jäljennöksiä patentti- ja rekisterihallitukselle alkuaan annetuista selityksestä, patenttivaatimuksista, tiivistelmästä ja piirustuksista.

This is to certify that the annexed documents are true copies of the description, claims, abstract and drawings originally filed with the Finnish Patent Office.

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L1

Adaptive media stream

Field of the Invention

This invention relates to media streams transmitted in a network, such as the Internet. Especially, the invention relates to media streams concerning video pictures and voice.

Background of the Invention

When media streams that contain continuous data, for example video pictures and voice, are transmitted in a network, such as the Internet, the speeds of the media streams have to be adjusted with the speed of the transmission connection available at the time. Often, in the case of video pictures, the adjustment is made by changing the quality of the pictures. The speed of a transmission connection in the Internet depends strongly on a user's Internet terminal. Some terminals support technically higher speed rates than others (usually older terminals). Thus, speed adjusted media streams must be offered for a variety of terminals.

Transmission speed may also vary with time. For example, when congestion happens in the network, the transmission speed may decrease considerably. After the congestion, the transmission speed returns to the normal speed rate.

Nowadays, most of the content of the Internet is in WWW servers, which use an HTTP protocol for transmitting desired contents to users. Originally, the HTTP protocol was not designed for continuous media streams (video, voice). The problem of the known solutions is that when a media stream has to be adjusted for a changed transmission condition, i.e. to be an adaptive media stream, a special software or protocol must be used, instead of the HTTP protocol. Real Server, Quicktime Server, and Windows Media Server are commercial server software, which support adaptive media streams. These software use special protocols, such as RTP (Real-Time Transport Protocol) and RTSP (Real Time Streaming Protocol), which are designed for the adaptive media streams.

However, using these software usually requires a user to invest and maintain parallel devices and software. If the user is a community, such as a company, support staff must be educated to use these systems. For a service provider this means in practice that a special media stream server

must be maintained. The goal of this invention is to eliminate these drawbacks. This is achieved in a way described in the claims.

Summary of the Invention

The idea of the invention is to change the source of an adaptive media stream when an available transmission speed rate changes. Each source contains essentially the same information (such as video and voice), but the suitability of each source for transmission has been adjusted to a certain speed rate. The coding of the source information can be different among the sources, which affects the speed rate. The picture information can be black-and-white instead of a color picture. The picture size can be smaller or larger. The video can be with or without voice. When the source is changed, also a new stream is created for the new source. In other words, the adaptive media stream comprises at least one media stream for transmitting information.

In an arrangement according to the invention a file, which contains sources for different media streams, is formed. At the beginning of the transmission the optimal transmission speed rate at the time is chosen. The source in the file, which corresponds to the available speed rate, is selected to be the source of the adaptive media stream. When the available transmission speed rate changes, either to be faster or slower, a command for changing the source of the adaptive media stream, is sent from the user's terminal to the service provider's server wherein the file of the service is. Commands are sent using an HTTP protocol. When the available transmission speed rate changes again, a new command for changing the source is sent from the user's terminal to the service provider's server. The commands are always sent when it is possible to use a higher speed rate or when a lower speed rate must be used.

Brief Description of the Drawings

In the following the invention is described in more detail by means of FIGs **1** - **3** in the attached drawings where.

FIG. **1** illustrates an example of the structure of a file according to the invention,

FIG. 2 illustrates an example of a flow chart describing the function of the inventive arrangement,

FIG. 3 illustrates an example of an arrangement according to the invention.

Detailed Description of the Invention

FIG. **1** describes an example of a file structure according to the invention. The file is in the service provider's server from where users can download it. Let's say the file contains a video in two different formats. At the beginning of the file there exists a header **1**, which contains starting bytes for two different media sources - the sources for the media stream. Source 1, i.e. stream 1 is a 320*240 video file with a speed rate 200 kbps **2**. The starting byte **4** in the file is 2000. Source 2, i.e. stream 2 is a 160*120 video file with a speed rate 40 kbps **3**. The starting byte **5** in the file is 800000. If the network and a user's terminal support the transmission speed rate 200 kbps then stream 1 is sent to the user - otherwise stream 2 is sent. Let's assume that 40 kbps is always available.

Stream 1 is sent to the user. The stream contains timing marks **6**, **7**, **8**, **9**, frequently indicating the byte of the file where the stream is running at the time and the corresponding byte **6A**, **7A**, **8A**, **9A**, in stream 2. If for some reason, the network can not transmit stream 1 with 200 kbps, or the user's terminal can not receive at this speed rate, the transmission of the video is changed to stream 2. For example, when the need to change the speed rate to a lower one is noticed and the next timing mark is, let's say, the mark **7** indicating time 1000 ms, it tells the corresponding byte 805000 in stream 2 to where the source of the transmission of the video transfers **11**.

In the same way, stream 2 contains timing marks **10**, **11**, **12**, **13**, frequently indicating the byte of the file where the stream is running at the time and the corresponding byte **10A**, **11A**, **12A**, **13A**, in stream 1. When the capability of transmitting 200 kbps is noticed during the transmission at 40 kbps rate, the transmission of the video is changed to stream 1. For example, when the availability of the higher speed rate is noticed and the next timing mark is the mark **13** indicating time 3000 ms, it tells the corresponding byte 77000 in stream 2 to where the source of the transmission of the video transfers **9**.

FIG. **2** shows an example of a flow chart, which illustrates a function and method of the invention. FIG. **3** shows an example of the inventive arrangement. When a user visits a home page of a service provider, he/she may find something he wants to order, such as a video show. The user sends **34** a request message from his terminal **33** to the service provider's server **31** through the network **32**, such as the Internet, to get the show using a GET method that is one of the methods, which belongs to the HTTP1.1 protocol. Let the request be:

GET http://www.serviceprovider.com/video/music/band3.html. HTTP/1.1

Mostly, the transmission speed rate depends on the available (and optional) processing speed of the terminal, so it is also sent a list of alternative speed rates from the user's terminal. The server chooses **21** one of the supported speed rate from the list. (It should be noticed that the server can be informed of the capability of a terminal in another way as well.) In this case, the user's terminal supports speed rates of 200 kbps and 40 kbps. Let's assume that the desired file **36** is the file in FIG. **1**. If the speed rate of 200 kbps **22** is available, stream 1 is selected **24**. Otherwise, the speed rate of 40 kbps **23** is chosen and stream 2 is selected **25**. (Notice that the higher speed rate means the higher bandwidth.)

In the selection of the speed rate of 200 kbps the server starts to play **26** stream 1 from the right byte (2000) of the file. The data and the timing marks are sent **35** to the user's terminal during the play. The terminal checks **28** frequently that the bandwidth is okay for the selected stream. If the bandwidth is OK, playing stream 1 is continued. If the bandwidth is too fast at any given time, stream 2 is selected **210** and stream 2 starts to play **27**, **311** from the right byte of the file defined by the latest timing mark. The bandwidth of stream 2 is checked **29** similarly as the bandwidth of stream 1, and when the bandwidth is again available for the speed rate of 200 kbps, stream 1 is selected **211**.

In the selection of the speed rate of 40 kbps the server starts to play **25** stream 2 from the right byte (800000) of the file. The data and the timing marks are sent **35** to the user's terminal during the play. The terminal checks **29** frequently that the bandwidth is okay for the selected stream. If the bandwidth is OK, playing stream 2 is continued. If the bandwidth is too slow at any given time, stream 1 is selected **211** and stream 1 starts to play **26**,

and is sent **311** to the terminal **33** from the right byte of the file defined by the latest timing mark. The bandwidth of stream 1 is checked **28** similarly as the bandwidth of stream 2, and when the bandwidth is again too fast for the speed rate of 200 kbps, stream 2 is selected **210**.

The checking of the bandwidth of the streams can be made, for example, measuring a filling degree of a buffer for incoming data in the user's terminal. When the buffer is becoming empty, the process is too fast compared to what is needed, and the speed rate can be dropped. When the buffer is becoming full, the process is too slow compared to what it can be, and the speed rate can be raised. After the measurement, the suitable stream is selected **210**, **211** and a GET command with an additional field RANGE is sent **310** from the user's terminal to the server for changing the stream. For example, let the GET command be GET http://www.serviceprovider.com/video/music/band3.html RANGE: bytes= 805000- when the transmission speed rate changes from 200 kbps to 40 kbps.

It is worth noting that when a stream is changed, a new whole stream (instance) is created and the old stream is terminated after the new stream starts playing. From the view of the user the desired file, such as a video show, seems to continue without any break thanks to the new stream starting to play from the right byte indicated by the timing mark. So, when the source is changed, also a new stream is created for the new source. In other words, the adaptive media stream comprises at least one media stream for transmitting information. Furthermore, it may be said that the adaptive media stream comprises several (or one if the speed rate remains the same during the whole transmission) instances (separate streams) of the same object (the adaptive media stream containing information such as video). Naturally, there are more ways to model the adaptive media stream, but common for these models are that transmission of information happens in the adaptive stream and a created stream under control of the adaptive stream handles the transmission of the information of a specific source.

For creating the inventive arrangement means **39** for choosing an original transmission speed rate and selecting a suitable source in a service provider's server is needed. In a user's terminal means **37** for checking the suitability of the transmission speed rate and means **38** for reselecting a suitable source are needed.

Although, the processing speed of a user's terminal is mostly the decisive element when selecting a suitable transmission speed rate, it may happen that the network becomes congested. In congestion, the available speed rate decreases and the transmission speed rate must be lowered. On the other hand, if the network allows a higher speed, the transmission speed rate may be increased.

Using the inventive arrangement, an adaptive media stream can be created with a normal HTTP server. Therefore, there is no need for the use of a special media stream server, or parallel devices and software. Remarkable cost savings are achieved, since usually service providers and users support the HTTP protocol. Also the reliability of the system increases because of fewer sources of faults.

It is clear that inventive arrangement can be implemented in many ways. For example, the time period between two timing marks can be different than in the example of this text. It can be any suitable period depending on the features of a solution, such as 2 or 4 seconds. The format of the inventive file can be any suitable format as well, such as MPEG or another.

The inventive file may comprise more than two different streams (containing the same content), from which the most suitable stream is selected at any given time. Therefore, timing marks must contain a number of references for the corresponding byte in the other data sources.

All the sources do not have to be in the same file, but each source can be a separate file. However, the use of this kind of structure is not as effective in the light of using as little processing power as possible compared to the use of one file structure. In the structure of several files, timing marks must indicate the right file with the corresponding byte.

Although, a sending terminal have been described to be a server in the examples above, it is clear that the sending terminal can be another terminal capable to send information.

According to the above-mentioned matters, it is evident that the invention is not restricted to the solutions described in this text, but it can be modified for various solutions, in the scope of the inventive idea.

Claims

1. A method for providing an adaptive media stream between a sending terminal and a user's terminal characterized in that the adaptive media stream comprises at least one media stream and the method comprises the steps of:

a) choosing a transmission speed rate for the media stream,

b) selecting a suitable data source for the media stream among sources containing essentially the same information, each source intended for a certain transmission speed rate,

c) playing the media stream,

d) checking the suitability of the transmission speed rate,

e) either continuing playing the media stream if the transmission speed is still suitable or,

f) selecting a new data source, which is suitable at the moment,

g) as a response for the selection of the new data source, playing a new media stream,

h) repeating steps d) to g) until the stream, which is played, stops.

2. A method according to claim 1 characterized in that step b) comprises the phase of reading a header field of a file, which contains at least two data sources, the header indicating the starting points of the sources and to which transmission speed rate each source is indended.

3. A method according to claim 2 characterized in that step c) comprises the phase of starting to read from the starting point of the selected source.

4. A method according to claim 1 or 3 characterized in that step d) comprises the phase of monitoring a filling degree of a buffer for incoming data in the user's terminal.

5. A method according to claim 4 characterized in that if the buffer is becoming empty or full, then step f) is chosen, else step e) is chosen.

6. A method according to claim 1 or 5 characterized in that the information of the selection of the new data source is transmitted from the user's terminal to the sending terminal using a GET method of an HTTP protocol with an optional RANGE field.

7. A method according to claim 1 characterized in that step g) comprises phases of terminating the old media stream after starting

to play the new media stream and creating the new media stream before playing the new media stream.

8. A method according to claim 1 or 7, characterized in that step g) further comprises the phase of reading timing marks in the data source for defining the right point to start playing the new media stream.

9. A method according to claim 1 characterized in that step b) comprises the phase of reading a header field of files, where each contains one data source, the header indicating the starting points of the source and to which transmission speed rate the source is indended.

10. An arrangement for providing an adaptive media stream between a sending terminal and a user's terminal, characterized in that the adaptive media stream comprises at least one media stream and the arrangement comprises:

a) means in the sending terminal for choosing a transmission speed rate for the media stream,

b) a data structure in the sending terminal comprising at least two data sources containing essentially the same information, each source intended for a certain transmission speed rate,

c) means in the sending terminal for selecting a suitable data source from among the sources for the media stream,

d) means in the user's terminal for checking the suitability of the transmission speed rate when the media stream is played,

e) means in the user's terminal for reselecting a suitable data source from among the sources for a new media stream.

11. An arrangement according to claim 10, characterized in that the arrangement further comprises means for playing the data structure in a way that the playing is started from the right point of the data structure.

12. An arrangement according to claim 11, characterized in that means a) comprises means for reading a message from the user's terminal, which defines alternative transmission speed rates.

13. An arrangement according to claim 11, characterized in that each source comprises timing marks, which indicate the corresponding point in the other sources.

14. An arrangement according to claim 13, characterized in that the arrangement further comprises a GET method of an HTTP proto-

col with an optional RANGE field for transmitting the information of the reselection of the suitable data source from the user's terminal to the sending terminal.

15. An arrangement according to claim 11, characterized in that means d) comprises means for monitoring a filling degree of a buffer for incoming data in the user's terminal.

16. An arrangement according to claim 11, characterized in that the data structure is a file containing the data sources.

17. An arrangement according to claim 16, characterized in that means c) comprises means for reading a header of the data structure, which indicates the starting points of the sources and to which transmission speed rate each source is indended.

18. An arrangement according to claim 11, characterized in that the data structure is a number of files, each of them containing one data source.

19. An arrangement according to claim 18, characterized in that means c) comprises means for reading headers of the files, which indicate the starting point of the source and to which transmission speed rate the source is indended.

L3

(57) Abstract

This invention relates to media streams transmitted in a network, such as the Internet. The idea of the invention is to change the source of the content of a media stream when an available transmission speed rate changes. Each source contains essentially the same information (such as video and voice), but the suitability of each source for transmission has been adjusted to a certain speed rate.

(Fig. 2)

L4

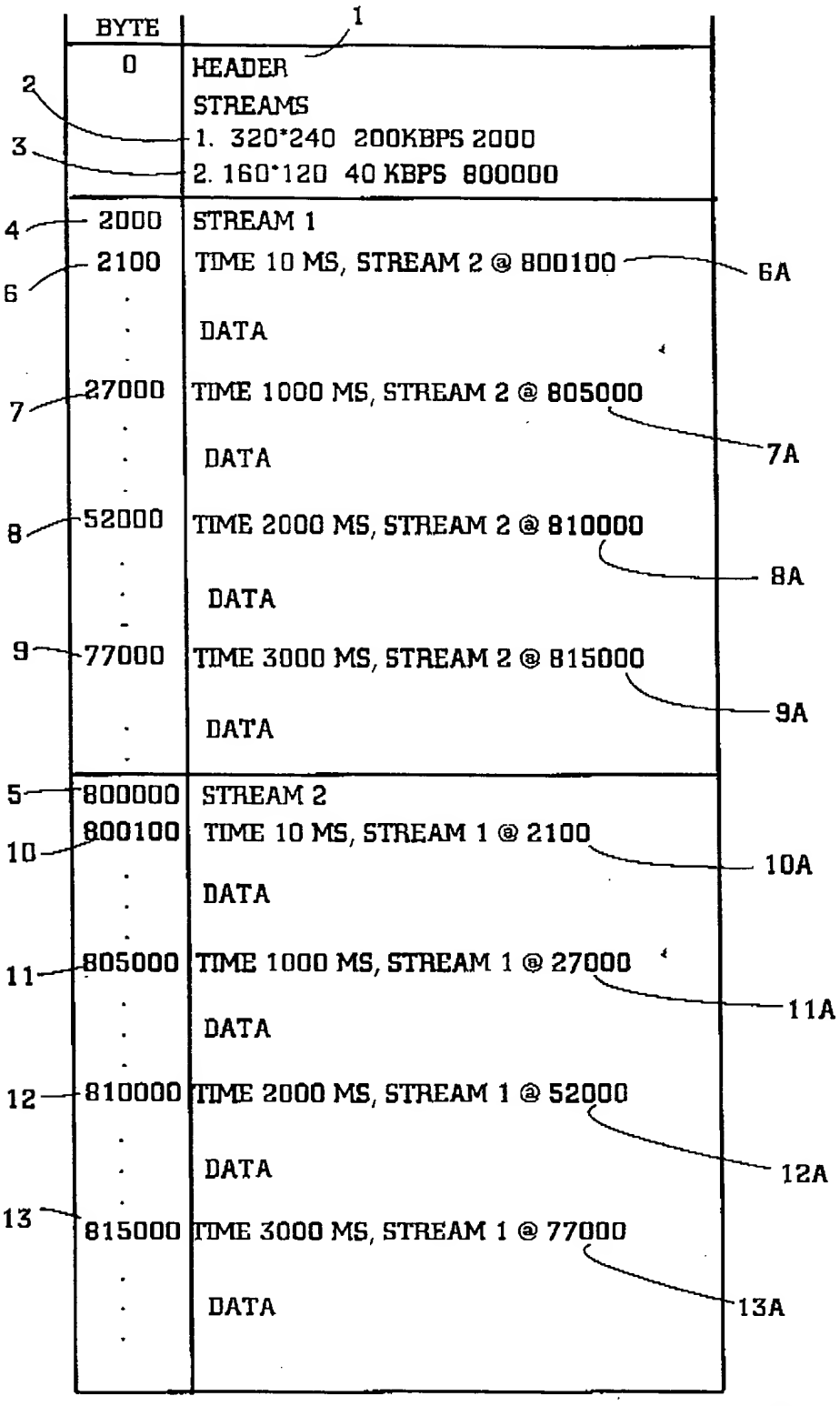
BYTE
1
0
HEADER
STREAMS
2
1. 320*240 200KBPS 2000
3
2. 160*120 40 KBPS 800000
4
2000
STREAM 1
2100
TIME 10 MS, STREAM 2 @ 800100
6A
6
DATA
27000
TIME 1000 MS, STREAM 2 @ 805000
7
7A
DATA
52000
TIME 2000 MS, STREAM 2 @ 810000
8
8A
DATA
9
77000
TIME 3000 MS, STREAM 2 @ 815000
9A
DATA
5
800000
STREAM 2
800100
TIME 10 MS, STREAM 1 @ 2100
10
10A
DATA
11
805000
TIME 1000 MS, STREAM 1 @ 27000
11A
DATA
12
810000
TIME 2000 MS, STREAM 1 @ 52000
12A
DATA
13
815000
TIME 3000 MS, STREAM 1 @ 77000
13A
DATA

FIG. 1

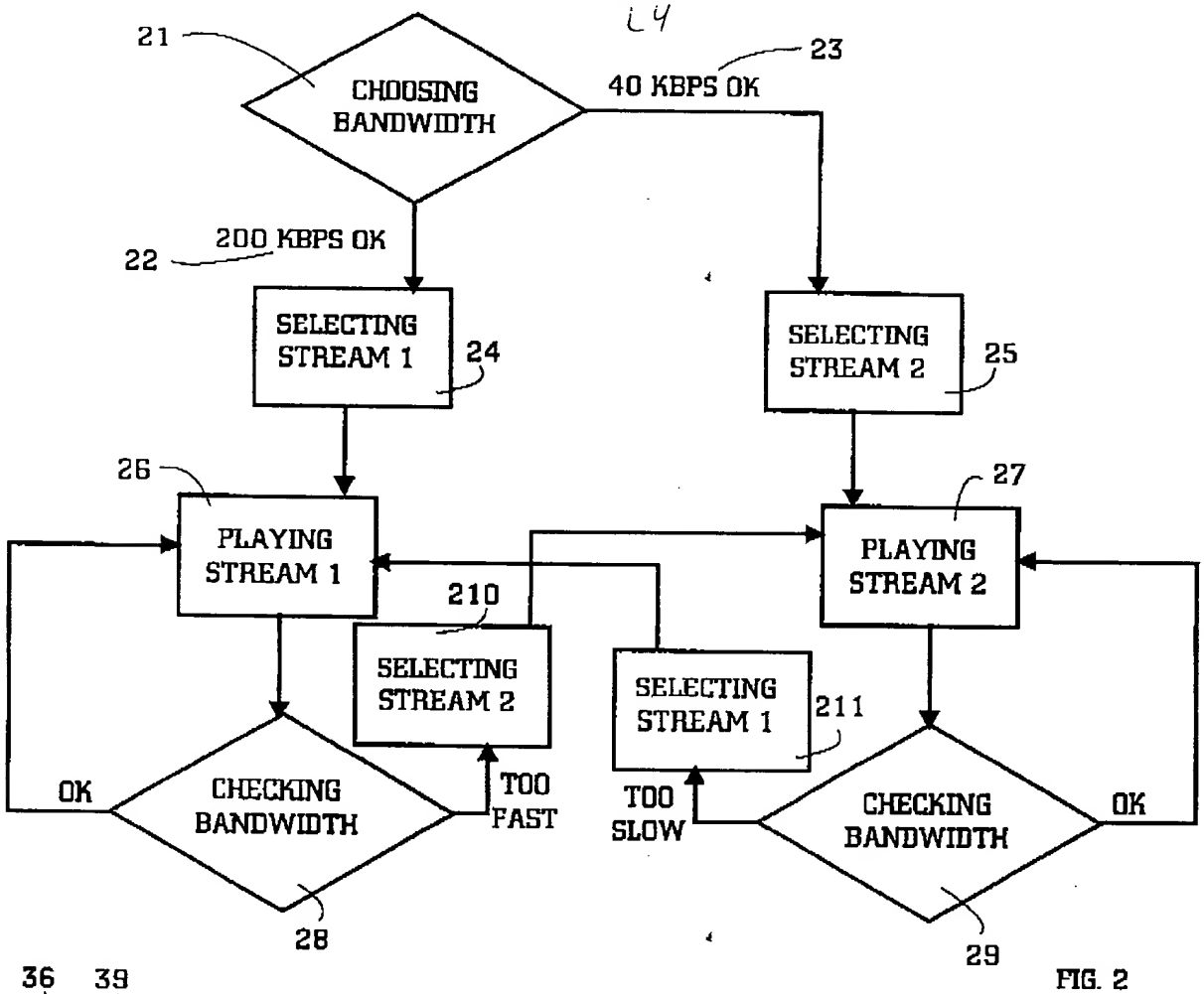
21
CHOOSING BANDWIDTH
23
40 KBPS OK
22
200 KBPS OK
SELECTING STREAM 1
24
SELECTING STREAM 2
25
26
PLAYING STREAM 1
27
PLAYING STREAM 2
210
SELECTING STREAM 2
SELECTING STREAM 1
211
OK
CHECKING BANDWIDTH
TOO FAST
TOO SLOW
CHECKING BANDWIDTH
OK
28
29

FIG. 2

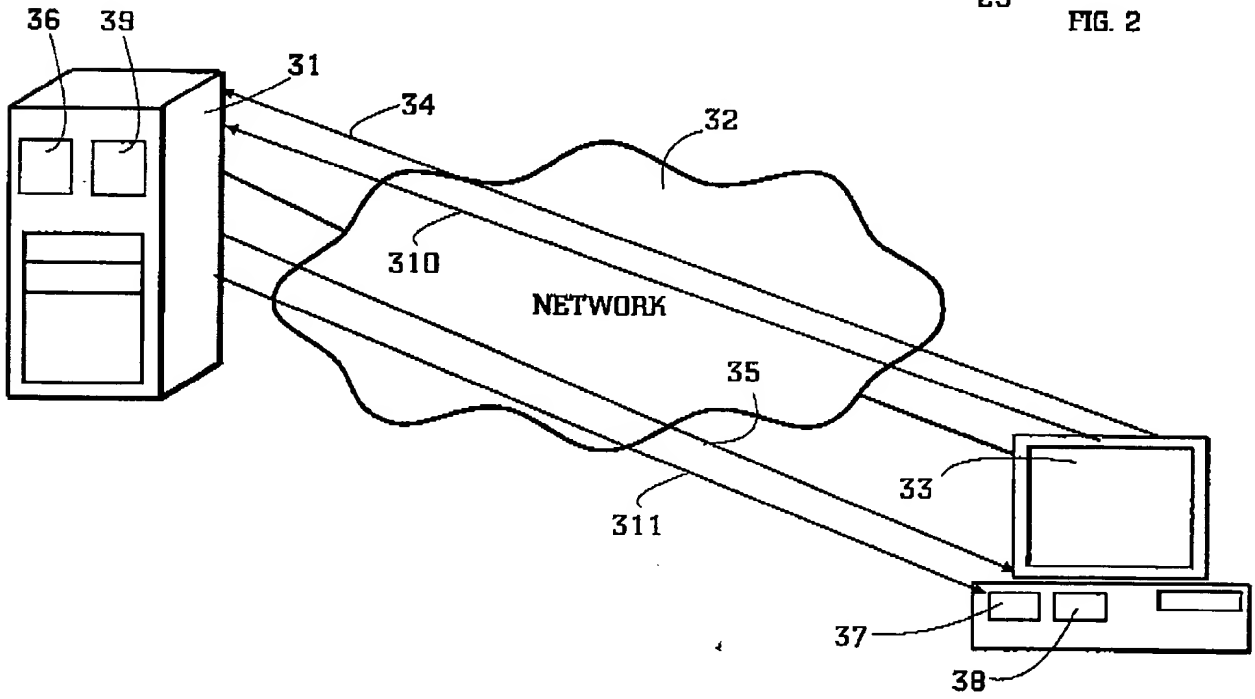
36
39
31
34
32
310
NETWORK
35
33
311
37
38

FIG. 3